

On Ian Hacking's Notion of Style of Reasoning

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Abstract The analytical notion of ‘scientific style of reasoning’, introduced by Ian Hacking in the middle of the 1980s, has become widespread in the literature of the history and philosophy of science. However, scholars have rarely made explicit the philosophical assumptions and the research objectives underlying the notion of style: what are its philosophical roots? How does the notion of style fit into the area of research of historical epistemology? What does a comparison between the Hacking’s project on styles of thinking and other similar projects suggest? My aim in this paper is to answer these questions. Hacking has denied that his project of styles of thinking falls into the field of historical epistemology. I shall challenge his remark by tracing out the connections of the notion of style with historical epistemology and, more in general, with a tradition of thought born in France in the beginning of twentieth-century.

1 Introduction

In thinking about scientific research we have become familiar with several analytical notions such as Ludwik Fleck’s ‘thought style’ (Fleck 1979 [1935]), Michel Foucault’s ‘episteme’ (Foucault 1969 [1972], 1994 [1966]), Thomas Kuhn’s ‘paradigm’ (Kuhn 1996 [1962]) and Imre Lakatos’s research programme (Lakatos 1978). In the 1980s the philosopher Ian Hacking, following the historian of science Alistair Crombie (1915–1996), claimed that there exist different scientific ways of knowing which have emerged at specific points of human history. To characterize them he introduced the notion of ‘style of reasoning’ and employed it to describe,

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among other things, how and why certain scientific concepts or certain questions and sentences come to be shared and discussed.

Ever since Hacking introduced this notion, many scholars have used it for investigating the history of concepts and of the sciences, the epistemic differences between distinct approaches to scientific research, the relationship between history and philosophy and even issues of learning and teaching science. However, despite its success no much work has been carried out in order to place the notion of style in its research context and investigate its philosophical roots.

Having briefly introduced Hacking's notion of style of reasoning in Sect. 2 I shall pursue the two main objectives of this paper: to place the concept of style in its philosophical perspective and to grasp fully its philosophical import. It will be a salient point of the first half of this paper that the concept of style should be analysed within the context of an area of research called 'historical epistemology', which studies epistemological concepts as objects that evolve. This point is all the more important since Hacking does not see his style project as falling into the field of historical epistemology (Hacking 1999, p. 72).

In Sect. 3 I shall present historical epistemology as an attempt to historicize Kant: while the latter found the conditions of experience in the universal structures of the mind, historical epistemologists find them in certain historical conditions for possible discourse. To my mind, the key point of historical epistemology is the idea of 'organizing concept' (Hacking 1999), which I shall develop in Sects. 3.2, 3.3 and 3.4: as I shall explain, organizing concepts are concepts, such as objectivity or probability, which structure our thought about the world. Although they are not permanent but historical, organizing concepts play a role similar to Kantian pure concepts in that they allow us to make judgments.

I shall argue that in Hacking the notion of style takes on a crucial role in studying how and why an important organizing concept, the concept of objectivity, changes over history. I shall conclude that his project of styles should be understood within the framework of historical epistemology, the study of organizing concepts (Sect. 3.6). From a different perspective, also the historians of science Lorraine Daston and Peter Galison, together with Ian Hacking and Arnold Davidson (2001) among the leading practitioners of historical epistemology (Daston 1994, p. 283), have also been involved in a study of the concept of objectivity (Daston and Galison 2007). Their ideas will be considered in the second part of Sect. 3, where I shall revisit the concept of style by suggesting analogies and drawing parallels. In Sect. 4 I shall draw an ideal line linking Hacking's project of styles, historical epistemology and a tradition of philosophy of science born in France at the beginning of the twentieth-century. In so doing I shall shed more light on the notion of style of reasoning.

2 The Styles Project

'The Styles Project' is the label used by Hacking in his "‘Language, Truth and Reason' thirty years later" (Hacking 2012) to describe his project of research that aims to investigate the philosophical significance of the thesis that there exist

distinct scientific ways of knowing which have emerged and stabilized at different points in the history of the sciences. Although over the last forty years Hacking has added to his original nucleus of ideas several constructive suggestions, his original thesis, sketched in his earlier papers on styles, namely “Language, Truth and Reason” (Hacking 1982) and “‘Style’ for historians and philosophers” (Hacking 1992c), has never been fully developed into a comprehensive theory.

In Crombie's view styles of thinking were enduring methods of scientific inquiry and conceptions of nature that emerged in ancient Greece and developed continuously. In his *Styles of Scientific Thinking in the European Tradition* he listed six styles: (1) the ‘postulational style’ exemplified by the Greek geometry, which consists of proof by deduction on the basis of explicit axioms; (2) the style of experimental exploration to control postulation; (3) the style of hypothetical construction of models by analogy in order to reveal the mechanisms of phenomena; (4) the taxonomic style, that is the ordering of variety by comparison and taxonomy; (5) the statistical style, which provides an analysis of regularities of populations and (6) the historical derivation of genetic development to explain the present as a development of the past.

Hacking provided to Crombie's concept a metaphysical essence by contending that a style is not, *tout court*, only a way of reasoning or a method of inquiry. He made precise claims about the features of styles that are dense in philosophical implications (Hacking 1982, 1983a, 1992b, c, 2002–2003, 2007, 2009): for instance, he claimed that a style introduces new types of objects and new criteria for the truth or falsehood of statements about those objects, that is new true-or-false sentences, i.e. sentences whose truth-value hinges on the style itself (*style-dependent sentences*). For example, according to Hacking the discovery of demonstrative proof in ancient Greece represents a sharp break in the development of mathematical reasoning:

those very sentences used to express the geometrical a priori propositions could not have that sense unless they were embedded in the practice of geometrical demonstration (Hacking 1983a, p. 457).

In other words the sense of sentences such as this:

Straight lines which are parallel to the same straight line and are not in the same plane with it are also parallel to one another (Heath 1908, Elements IX, 9 p. 290).

is determined by the way in which we can reason for their truth or falsehood, in this case by the postulational style (number 1) in Crombie's list above). Hacking thinks that these sentences above could not have been candidates for truth or falsehood for, say, the Babylonian mathematicians, even if a definition of infinite planes, straight lines (the ‘new objects’ introduced by the postulational style) had been given to them. Indeed, terms such as ‘point’ and ‘straight line’ in those sentences are embedded in ways of reasoning and doing unknown to Babylonian mathematicians. Among other things, a Babylonian would have had to learn to *reason* as a Greek and rely on a new type of evidence in order to make sense of those sentences above. For

Hacking proof and diagrams are Greek ‘inventions’, crucial to make sense of Euclid’s sentences.

It is worthy of note that in the few lines that precede Hacking’s passage above, Hacking reminds the reader that:

empirical propositions, to be established from case to case by measurement are to be distinguished from a priori and demonstrable propositions of geometry.

We can say that my example of *style-dependent* propositions above must be distinguished from *style-independent* propositions such as:

The side of this pyramid is one meter long

or

Two sides of this trapezoid are parallel

Indeed, for Hacking these sentences above have a truth-value that is *independent* of any way of thinking.

As this example shows, in striking contrast with Crombie’s continuism, Hacking maintains that styles have sharp beginnings and that some of them have recent origin (Hacking 1983a, 1991, 2006a, b [1975], 2007, 2009, 2012). For instance, for him the statistical style emerged in the seventeenth century when certain historical conditions for the emergence of the idea of probability came into being.

Hacking also modified Crombie’s list in some respects (Hacking 1982, 1992c). For example, he reorganized the experimental and the analogical style by introducing the ‘laboratory style’ and considered *Leviathan and the Air Pump* (Shapin and Schaffer 1989 [1985]) as a book about its origins. According to Hacking the programme of experimentation developed in the seventeenth century by Robert Boyle (1627–1691) and his colleagues introduced a novelty in the way humans used experimenting: the invention of a place, the laboratory, in which instruments are built in order to elicit phenomena that do not exist in isolation. The production of effects, phenomena that require special devices to be elicited, represented a new form of evidence that characterized a novel way of thinking, the laboratory way of thinking.

Hacking also spoke of the now extinct hermetic style of Paracelsus (Hacking 1982, 1983b, 1992c): in Renaissance medical textbooks we may find statements that are unclear to us; for him this does not happen because they are false when judged from our current mode of reasoning, but rather because what settles their truth-value is only the style of reasoning of the Renaissance thinkers itself. In addition, he mentioned briefly the Indo-Arabic style of applied mathematics, concerned with finding algorithms and distinct from the style of geometry (Hacking 1992a), and hinted at the possibility of other styles (Hacking 1982; Lakoff 2012).

For my purposes, I wish to underline that for Hacking a style is not simply a new way of reasoning: it is “[a way of] finding out ‘that’ so and so, but also, finding ‘how to’. Finding out what’s true, and finding out how to change things” (Hacking 2012, p. 3). Importantly, a style relies on a new kind of evidence for ‘finding out in the sciences’ (Hacking 2012, p. 3) and involves new types of explanations, criteria,

laws, classifications, candidates for truth-or-falsehood and sentences that have no sense for someone who reasons in a different style (Hacking 1982).

3 Historical Epistemology and Styles of Thinking

3.1 Historicizing Kant

In one of his first papers on styles of thinking, Hacking pointed out a difference between his project and Kant's philosophy:

Kant did not think of scientific reason as a historical and collective product. We do (Hacking 2002c [1992], p. 181).

One of Kant's problems was to understand how judgements become possible: to determine what he called the 'transcendental conditions', i.e. the 'conditions of possibility' of our concepts. He believed he could state them independently of history or necessary constraints imposed on us from outside. Indeed, the Kantian transcendental conditions are related only to the structure of human thought—it is reason that imposes them on the raw sense data by making a set of sensations objective experience. In particular, the spatial and temporal forms of intuition represent the conditions within which we perceive objects as existing in space and time and within which the propositions describing these objects have a truth-value. Since transcendental conditions are prior to experience, Kant referred to them as a priori conditions.

It must be emphasized that Kant was engaged in a particular stage of scientific process, Newtonian science,¹ which for him explained the world of appearances. In order to justify the kind of necessary universal laws proposed by Newton he defended the intellectual structures underlying Newtonian mechanics: Euclidean geometry, continuous classical time, absolute space and the concepts of causality and substance. In contrast, Hacking set out to solve the problem of why objectivity is possible in the aftermath of the upheavals of quantum theory and the theories of relativity, which had resulted in a non-Newtonian conception of space, time and motion.²

Kant's solution could not be satisfying for Hacking because in his view the truth-value of a sentence is fixed by contingent historical circumstances. He rejects the picture according to which certain propositions are not affected by the methods of inquiry that we deploy in a certain historical context: although the statements of the theory of probability might be true at any time, they could not be uttered until the mid-seventeenth century, when certain conditions for their emergence came into being, e.g. the new 'evidence of things', a new way of reading signs in things (Hacking 2006b [1975]). Therefore, for Hacking, Kant's claim that the conditions of experience can be

¹ For a comprehensive account of Kant's scientific sources see (Calinger 1979).

² The first chapters of *Causality and Chance in Modern Physics* (Bohm 1984) provide a clear exposition of why quantum mechanics brought about a renunciation of causality.

found in the structure of the human mind is to be rejected because it jars with the results of historical analysis—if anything, these conditions must be impermanent.

How did Hacking characterize these impermanent conditions? The answer can be found in the notion of ‘organising concept’ mentioned in the paper *Historical Meta-epistemology* (Hacking 1999), a title which alludes to the field of research denoted ‘historical epistemology’ by many scholars, without the prefix ‘meta’ (I shall use the same label or the acronym HE):

[Historical meta-epistemology] is, first of all, ‘meta’ epistemology in that it talks about very general or organizing concepts that we use today, and which have to do with knowledge, belief, opinion, objectivity, detachment, proof, probability, argument, reason, rationality, evidence. It is not directly epistemology, in the sense of a theory of knowledge (etc.), but a study of ideas about or uses of knowledge (Hacking 1999, p. 53).

Hacking did not introduce the idea of ‘organizing concept’ systematically although his writings contain hints that help to reconstruct its meaning. Since I consider this idea central both to explain what HE is and to understand the place of the notion of style within this field of research, I shall start my analysis by spelling out what *organising* concepts are. I shall return to this passage once I have accomplished this task.

3.2 From Kantian Categories to Organising Concepts

A good start for a discussion about organizing concepts might be to remember that Kant’s categories (and the two innate intuitions of space and time) lie at the top level of our conceptual organization. To such a degree that according to the *Critique of Pure Reason* (Kant 2007 [1781]), there could not be *empirical* concepts without *organising* concepts such as a priori categories: the former are forged from the raw material of experience by applying the categories to intuitions.

Like the Kantian categories, the organising concepts studied by HE (e.g. probability and objectivity, mentioned in the passage above) ‘govern and control ground level concepts’ (Hacking 1999, p. 65); however, unlike Kantian categories, organising concepts may change or come into being through specific historical processes. When they emerge, they come to shape our practices of knowledge, direct us in what to do, fashion our concepts, structure the ways in which the ideas that permeate our world are connected. In this sense, organising concepts are the conditions of the possibility of our experience. As such, although they are changeable throughout history, they are indispensable for knowing:

they are [...] essential to the very functioning of our society. We are stuck with them, which is not to say [...] that they are not changing as I speak (Hacking 1999, p. 65).

By saying that organizing concepts are ‘essential’ to the very functioning of our society Hacking means that “they produce a feeling of inevitability” (Hacking 2002a, p. 21): when we think of an organizing concept we find it difficult to

conceive of a way of experiencing our world and ordering our society which does not rely on it. In this sense they are 'inevitable'.

To sum up, an organizing concept is an epistemological concept that: (1) structures our thought about the world; (2) has emerged in the course of history or has changed over time; (3) is inevitable. As an example of *non*-organizing concept Hacking considers the concept of horse: it is not essential to our thinking about the world and it is a concept that 'we can understand totally outside the history of any idea' (Hacking 1999, p. 59). I am going to clarify points (1)...(3) above by discussing two examples of organizing concepts: probability and objectivity.

3.3 Probability as an Organising Concept

In *The Emergence of Probability* Hacking argued that the concept of probability emerged in the mid-seventeenth century. According to him, in the Renaissance the evidence of things³ was lacking and the world testified by its signs. Later on different scholars maintained that signs can be imperfect and only often right. Credibility and frequency were thus linked. Then, conventional signs were distinguished from natural signs and the concept of evidence of things conjoined with that of frequency took shape. Hacking thinks of this transformation as a discontinuity in history which opened a space for the emergence of probability.

The coming to the fore of probability was not only followed by the emergence of new style-dependent sentences (e.g. the statistical sentence 'The adult height for one sex in an ethnic group follows a normal distribution') but also by new criteria (e.g. best fit), types of explanation (e.g. statistical distributions), laws (e.g. the law of large numbers), classifications (e.g. society is divided into genres of people (Hacking 2008 [1990], p. 134)) and new objects (e.g. the population characterized by a mean and standard deviation).

In other words, the concept of probability has come to structure our experience (point 1) above) in many ways. First of all, it shapes the way we know: to prove a statistical sentence involves, for all intents and purposes, a whole body of practices, from selecting samples to measuring, classifying, dealing with errors or assessing the difference between experimental distributions and theoretical ones. Secondly, concepts such as sample, population, distribution and various criteria of assessing statistical statements are constituted within a 'space of possibilities' opened by the concept of probability. That is, the emergence of the latter has allowed the coming to the fore of a domain of scientific discourse, with its conceptual material, its practices and its theoretical structures.

Other concepts such as variability, correlation and uncertainty, which occupy a pivotal role in our ways of thinking about our experience, are couched and conceived of in terms of the concept of probability. The latter gives rules for the usage of these concepts: for example, uncertainty is thought of in terms of standard

³ To use the example given by Austin (1911–1960) and quoted by Hacking (2006b [1975], p. 32), pig-like marks and buckets of food outside a sty represent the *evidence of things* for the statement that in the sty there is a pig. Obviously, in the Renaissance people did use the evidence of things, but for Hacking the concept was absent: 'dogs and boars can tell there is a pig, and do not thereby have a concept of evidence' (Hacking 2006b [1975], p. 34).

deviation, which in turn is defined in terms of a probability distribution. Through the concept of probability other concepts, such as ‘life expectancy’, are connected with the concept of mean and statistical distribution. We can say that the *organising* concept of probability governs and controls the way *ground level* concepts such as variability, correlation, uncertainty, expectancy, mean, distribution, population are thought of or related one to another.

Finally, the ‘feeling of inevitability’ (point 3) above) mentioned by Hacking is provided by the fact that we now cannot conceive of understanding the world without the concept of probability: it has come to determine the way we organize our thinking and how strongly we ought to believe that something will happen—much so that ‘the mean and dispersion are now thought of as objective properties of some part of the world, as “out there” as the location of a planet’ (Hacking 1992b, p. 148).

3.4 Objectivity as an Organising Concept

According to Daston and Galison modern objectivity is a conglomerate of many conceptual components with their own history. They set out to reveal these distinct components by analysing scientific atlases, “those select collections of images that identify a discipline’s most significant objects of inquiry” (Daston and Galison 2007, p. 17). The centrality of atlases comes from the fact that they “set standards for how phenomena are to be seen and depicted” (Daston and Galison 2007, p. 19). In particular, Daston and Galison analysed atlases in order to gain insights into three conceptions of objectivity that came about in the last three centuries: *truth-to-nature*, *mechanical objectivity*, and *trained judgement*.

Truth-to-nature emerged in the eighteenth century when scientists started to be afraid of being overwhelmed by the chaos of sensations of natural phenomena: too many non-essential details could hinder the knower from describing properly a phenomenon. Lisa Jardine described how some technological factors (enhanced microscopic observation, chemical analysis, autopsy, *camera obscura*) produced a blinding intricacy of details that made it easy to fail to see the whole picture of a phenomenon (Jardine 2000 chapter three). As a reaction to all that, Daston and Galison argue, scientists appealed to reason in order to find the hidden order behind the monstrosity of nature; they trained themselves to prune, shape, select and represent things in such a way that only what was *typical* of a certain class of objects could be recognizable (Daston and Galison 2007, p. 56).

In the first decades of the nineteenth century, scientists started to criticize the artistic portrayals and praise the techniques of photography that were emerging. They ceased being concerned about being overwhelmed by nature and started to fear to project their theories into nature, deforming it. As a consequence, they tried to repress truth-to-nature, the predisposition to idealizing and perfecting. For example, Daston and Galison quoted the Berlin bacteriologist Carl Fraenkel (1861–1915) as saying:

A drawing can only be the expression of a subjective perception and therefore must, from the beginning, renounce the possibility of an objection-free

reliability. [...] The photographic plate, by contrast, reflects things with an inflexible objectivity as they really are (Daston and Galison 2007, p. 177).

Mechanical objectivity came to the fore as a 'passionate commitment to suppress the will, a drive to let the visible world emerge on the page without intervention' (Daston and Galison 2007, p. 143).

In the twentieth century mechanical images became complex and needed to be interpreted and compared. According to Daston and Galison many scientists began to regard certain images as unreliable because of the abundance of incidental details and artefacts. As an example of the inadequacy of mechanical objectivity consider that, when the radiologist Rudolf Grashey (1876–1950) wanted to classify X-ray images of human organs in order to distinguish the normal from the pathological, the mechanical registration of images could not be the solution: he was forced to decide which of them represented deviations within normality and choose some of them as a boundary post of the normal (Daston and Galison 2007, p. 344). In short, the insistent drive to repress the wilful intervention of the scientist did not prove adequate to answering the need for interpreting, highlighting and handling images. In many cases a *subjective* decision was a necessary supplement to mechanical images or the mathematical techniques. Daston and Galison called this supplement *training judgement*.

In *Objectivity* Daston and Galison also mentioned another form of objectivity, *structural objectivity*, which counters the hermetic privacy of the self: the visual was to be distrusted and only relationships and structures were to be relied upon (Daston and Galison 2007, pp. 253–307). On her own Daston also introduced the concept of *communitarian objectivity*: it emerged in the nineteenth century and demanded "the severe curtailment of individual and/or local autonomy in choice of instruments, methods, and even research topics, in the name of solidarity" (Daston 1999, p. 86).

According to Daston and Galison each conception of objectivity is rooted in an *epistemic virtue*, as they call the scientific ideal to which scientists are committed in a particular period or circumstance. Indeed, consider first that for Daston and Galison

scientific objectivity always counters some aspect of the self, but not always the same one. [...] Because the subjectivity is multifarious, objectivity must be too (Dear et al. 2012, p. 31).

For example, mechanical objectivity is the expression of the fear of one's subjectivity (Daston and Galison 1992, p. 83): it opposes the post-Kantian unified self organized around the will (Daston and Galison 2007, p. 199). On the other hand, the enemies of truth-to-nature and trained judgment are external, Daston and Galison argue: the overwhelming wealth of irrelevant variations of nature for the former and the clutter of incidental details and artefacts for the latter. The battle is fought by what Daston and Galison depict as different prototypical knowers of nature, which in turn correspond to the different epistemic virtues: the 'insightful sage' (truth-to-nature), the 'diligent worker' (mechanical objectivity), the 'trained expert' (trained judgement) (Daston 1999, pp. 98–100) (Daston and Galison 2007, pp. 216–233). These scientific *personas* cultivate particular traits of the self and

pursue different values at the expense of others. Epistemic virtue is therefore the term with ethical overtones that Daston and Galison use to describe the values pursued by scientists in the battle for knowledge against powerful enemies such as those just mentioned. In this sense truth to nature, mechanical objectivity, trained judgement can be seen either as epistemic virtues *or* as different forms of objectivity. In conclusion, there is a plurality of epistemic virtues or, alternatively, different forms of objectivity, which oppose different sorts of subjectivities and serve the common ideal of being faithful to nature.

Having drawn from Daston and Galison the idea of how the concept of objectivity changes and evolves (point 2)), it is possible to note how it organises our experience of the world (point 1)). At a certain moment in history one or more conceptions of objectivity (i.e. epistemic virtues) come to represent the governing principles according to which we plan our experiments, decide which kinds of instruments to use and which ones discard, train our senses to make subjective decisions, establish which details of a phenomenon omit. Concepts such as standard of evidence, reliable method and valid argument and the way they are related one to another presuppose the meta-concept of objectivity. By creating relations of significance, epistemic values direct research into certain directions, as Martin Carrier illustrated (Carrier 2012). Daston herself has implicitly recognised the organising role of the concept of objectivity by characterizing her work as part of a field of research which aims at providing ‘the history of the categories that structure our thought, pattern our arguments and proofs, and certify our standards of explanation’ (Daston 1994, p. 282). Finally, although the concept of objectivity changes it is essential to the structure of our thinking about the world (point 3) above). Indeed, it is the condition of possibility for the entire domain of scientific discourse which concerns the justification of our claims. Only if we have an idea of what objectivity means can we decide which methods of justification are valid. For example, once we conceive of objectivity as the idea that appearances are to be represented as they are (‘mechanical objectivity’) we are able to establish whether photographs or drawings should support scientific claims about fossils in a textbook.

3.5 Historical Epistemology Versus Traditional Epistemology

Having put forward a characterization of organising concepts, I shall now return to Hacking’s passage at the end of Sect. 2 in which he defines historical epistemology. Among other things, he says that HE is not a theory *of* knowledge. Indeed, traditional epistemology studies the conditions, the limits and the sources of knowledge and inquires into what makes knowledge scientific. It considers concepts such as proof, rationality, objectivity, evidence and the like as permanent and, to understand them, it analyses the timeless structure of logic and consults human understanding. HE starts from an opposite presupposition: even though organizing concepts are necessary for our thinking, they get their meaning from the uses we make of them in a certain period of history and the way in which they are connected with other concepts. They are ‘situated’: they ‘have no constitution other than tradition and use’ (Hacking 1999, p. 56). Furthermore, HE cannot be assimilated to the history of ideas either: the latter is generally centred on the subject and tells how

key concepts are transmitted from a thinker to another. Historical epistemology, on the other hand, is an inquiry into the very general structures in which human beings think. In conclusion, unlike traditional epistemology, HE does not formulate or defend theories of knowledge; rather, it reflects on the historical conditions under which we know, that is on organising concepts.

Over the past few years HE has been used as a label for a wide variety of programs (for an overview see Feest and Sturm 2011). In addition to Daston and Galison, who characterized epistemological categories out of knowledge practices, another practitioner of HE, Arnold Davidson, conducted investigations into the conceptual formation of new disciplines and mentioned historical epistemology in relation to a kind of study that attempts to show how novel forms of experience are linked to the emergence of new structures of knowledge (Davidson 2001, p. XIII).

In nuce, historical epistemologists make a double claim: (1) *at a particular stage* of history there is a set of organising concepts that play a role similar to Kantian pure concepts by allowing us to make judgements; (2) organising concepts are not permanent. By bearing in mind these two points, historical epistemology can be viewed as the historicization of Kant. In other words, the qualifier 'historical' in the expression 'historical epistemology' alludes to a radical departure from Kant, to the historicization of 'pure concepts'.

3.6 The Styles Project as a Study in Historical Epistemology

Few passages of Hacking can be more illuminating than the following one for those who want to understand the philosophical perspective of the styles project:

my study is a continuation of Kant's project of explaining why objectivity is possible (Hacking 2002c [1992], p. 181).

Although Hacking makes a fundamental departure from Kantian philosophy by suggesting that what is objective is the result of historical and social circumstances (Sect. 3.1), in the passage above he shares Kant's research aim: to explain what makes objectivity possible. For him, the notion of style is the analytical tool which can help us to achieve this aim.

my styles of reasoning, eminently public, are part of what we need to understand what we mean by objectivity. This is [...] because they have settled what it is to be objective (truths of certain sorts are what we obtain by conducting certain sorts of investigations, answering to certain standards) (Hacking 2002c [1992], p. 181).

Styles are what settles what it is to be objective because, when a style comes about, it brings into a being [or 'introduces' to use Hacking's term (Hacking 1982)] a set of novelties, in particular a new kind of evidence. This new form of evidence provides the new criteria by which new sentences become candidates for truth or falsehood, i.e. *objective*. I use deliberately the term 'objective': in his styles project Hacking often uses interchangeably qualifiers such as 'meaningful', 'true-or-false', 'objective'; in his terminology, when in a community that adopts a given style certain sentences come to be 'up for grabs as true or false' (Hacking 2002b [1982], p. 160),

they become *objective*; and when concepts, questions, conjectures, problems, solutions come to be shared and discussed, in short, when they become ‘possible’, they become *objective*.

In other words, in Hacking ‘objectivity’ refers to the fact that a community of people shares the presuppositions of its styles (e.g. its standards of evidence, methods, questions and so on); so when a new style emerges it generates a new form of objectivity. To give an example, the postulational style introduced new types of objects, e.g. straight points, lines and planes, and new criteria for the truth or falsehood of statements about those object, i.e. sentences whose truth-value hinges on the style itself. In the ancient Greece the diagram became *the* standard of evidence by which the geometrical propositions in Euclid’s *Elements* became objective: they could be assessed as true or false.

Having described the aims of historical epistemology and how the notion of style is related to the concept of objectivity we are now ready to answer the question as to whether the styles project can be viewed as a specific study in HE. Surprisingly, Hacking’s answer is in the negative:

Anyone who has come across some published sketches of ideas in progress [the styles project] might think this was an example of historical meta-epistemology: absolutely not! (Hacking 1999, p. 72)

On his part, Martin Kusch has answered is in the positive: ‘Hacking’s analysis *historicises* reason, historicises what counts as a scientific proposition, and historicises what passes for a scientific entity’ (Kusch 2010, p. 158). My answer is in the positive too for the following reason: both methods and results of the styles project are part of the methodological and conceptual apparatus of HE. Indeed, to start with, I recall from the previous quotation that Hacking declared that his ‘styles of reasoning [...] are part of what we need to understand what we mean by objectivity’ (Hacking 1992c, p. 181). In this sense, the scope of the theory of styles is identical to one of the objectives of HE—to understand an *organising* concept, objectivity, which undergoes mutations and evolves along with the changes of our practices. However, as I have explained in Sect. 3.3, it is the mutation of a ‘way of being objective’, e.g. the evidence of signs, which might make possible the emergence of a new style. Therefore, the reverse of Hacking’s sentence is also true: what we mean by objectivity, its study, is necessary to explain what a style of reasoning is. But for Hacking objectivity is an organising concept to be studied by using the methods of HE, so the latter is necessary for elaborating a theory of styles.

In parenthesis, it is worth noting that whereas the concept of objectivity is an organizing concept, the concept of style of reasoning is not. Indeed, the latter is not a concept that we must possess in order to organize our thought about the world, although for Hacking it is a useful instrument in the hands of the philosopher or the historian of science. The concept of objectivity structures our thought and patterns our practices of knowledge; the concept of style provides an ordering of the record and helps the work of the historian and the philosopher [see also (Hacking 1992c, p. 1)]. The concept of style is not a transcendental concept possessed by all human beings of the sort that could be compared to Kant’s pure concepts. In other words, what the concept of style lacks is *universality*, a feature that, conversely,

characterizes the concept of objectivity. Outside science, in their expression of imagination and creative skill, people may well persistently ignore objectivity. However, in order to do their best to get rid of it they must have the idea of what to be objective means. Even though objectivity may not be the organizing principle in the arts, it is essential to the functioning of our society and our daily life. It is present in our minds when we discuss the election results, when we apply the law, when we try to eliminate subjective valuations in our relations with other human beings. On the other hand, we can say that the concept of style is used by the philosopher in order to understand an organizing concept, that of objectivity, which reminds us of the Kantian transcendental concepts: to reason in a certain style (and not: 'to possess the concept of style') amounts to adopting certain criteria and standards of evidence and therefore a form of objectivity.

3.7 Styles of Thinking and Epistemic Virtues: Some Substantial Convergences

I wish to conclude this section by pointing out some substantial convergences between the notion of style and the notion of epistemic virtue. In Daston and Galison the concept of epistemic virtue is inseparable from the concept of objectivity: there is an epistemic virtue for each form of objectivity. The concept of epistemic virtue is simply the other side of the concept of objectivity or, *rectius*, each epistemic virtue represents the other side of a conception of objectivity: as Daston and Galison say, each conception of objectivity is 'rooted' in an epistemic virtue or, equally, in an epistemic fear (Daston and Galison 2008, p. 671). Styles have a different relationship with objectivity: they represent that collection of ways of reasoning, standards of truth, methods and criteria which are the conditions for the objectivity of certain concepts and statements.

As a further point, notice that according to Daston and Galison certain historical contingencies, e.g. the discovery of photography, are crucial for the emergence of certain forms of objectivity, e.g. truth-to-nature. Epistemic virtues, therefore, like styles, are made possible by contingent reasons; they can then conflict with each other or intertwine, and, in principle, vanish; when a new epistemic virtue comes into being, the old ones do not necessarily pass away. Here, the resemblances between the notion of epistemic virtue and that of style are striking.

Furthermore, Daston and Galison say that

Atlas users become the people of a book, which teaches them how to make sense of their sliver-world and how to communicate with one another about it (Daston and Galison 2007, p. 27).

It is a sliver-world because, as matter of fact, atlases *select* what is important to ask, see, depict, teach and learn so that they exclude portions of the world, questions and perspectives. This may mean that for the members of a community who pursue certain epistemic virtues some aspects of phenomena (those that have been excluded) cannot play any role in the evidential considerations that bear on their knowledge. For example, the physicist Arthur Worthington (1852–1916), by relying only on his eyes, made symmetrical drawings of the impact of drops of liquids

falling vertically on a surface of water (Daston and Galison 2007, pp. 11–16). In other words, Worthington discarded some features of the phenomenon in the name of the ideal of symmetry. Later on, after having succeeded in stopping a droplet's splash with a photograph, which showed that the phenomenon was anything but symmetrical, he converted to the 'objective view', i.e. to the epistemic virtue of mechanical objectivity. Arguably, under the new possibilities of a 'mechanical objective vision', those variations that had been discarded under the 'truth-to-nature vision', could have become the *evidence* for more accurate theories that describe the splash of a drop. Ultimately, epistemic virtues select and exclude portions of the world and shape what can and what cannot be considered as 'evidence'. Similarly, styles select and exclude, opening a specific space of possibilities and relegating to oblivion questions, concepts and kinds of evidence. A case in point is the historico-genetic style: the community of scientists that in the nineteenth century adopted it turned their eyes to a previously 'unnoticed' portion of the world that became the evidence for their new theories: fossils, minerals, rocks and geological layers.

4 The Roots of the Styles Project

When the label 'historical epistemology' (*Historische Epistemologie*) appeared for the first time Hacking thought that it was inappropriate. For him that label was too full of reminiscences of a book by Dominique Lecourt entitled *L'Epistémologie historique de Gaston Bachelard* (Lecourt 1969). He meant that the expression 'historical epistemology' already indicated a tradition in philosophy of science whose main protagonists were Gaston Bachelard (1884–1962) and Georges Canguilhem (1904–1995) (Hacking 1999, p. 54). The prefix 'meta' he added was intended to mark a distinction with that prior use: 'for Bachelard objects are the sciences in their historical development [...] our objects of study are different, not knowledges, but ideas about knowledge' (Hacking 1999, pp. 54–55).

However, other practitioners of HE did not follow Hacking in the use of the prefix 'meta' and continued to use the label 'historical epistemology'. Consequently, today there is some ambiguity in its use. 'Historical epistemology' indicates both the variety of projects mentioned in the previous section and an older tradition of thought in philosophy of science born in France at the beginning of the twentieth century, when different thinkers started to reflect on the historical conditions of knowledge. To avoid confusion, I shall follow Cristina Chimisso who called the latter 'classical historical epistemology' (henceforth CHE) in order to distinguish it from HE (Chimisso, 2010).

In this section, I want to show that the underlying assumptions of the styles project can be traced back to classical historical epistemology (CHE). It will be my contention that CHE, which represented a shift of interest in theory of knowledge previously focused on finding the correct method of science, continues until today under various forms.

4.1 Origins of Historicization of Epistemology

Thomas Kuhn's *The Structure of Scientific Revolutions* (Kuhn 1996 [1962]) is widely presented as the book that produced a decisive transformation in the predominant image of science as exhibiting progress and methodological unity. However, at the beginning of the twentieth century the attempt to identify the credentials of scientific knowledge was began to be set aside and a space for a historicization of epistemology was opened up. It had become clear that scientists' practices do not follow a timeless rule but are subject to a historical development and that the way in which human beings reason changes throughout history. Much later, fuelled by various scientific and philosophical developments, this philosophical attitude led to a historicization of all the categories associated with science.

Recently, several scholars have identified different pivotal points of history in which classical epistemology came under attack (Rheinberger 2010, pp. 5–8, Gutting 2005). In her *Writing the History of the Mind* (2008) Chimisso presented a set of projects whose common presupposition was that 'the mind could not be studied a priori, and that ways of thinking were different in different civilizations' (Chimisso 2008, p. 3). For her, Gaston Bachelard and Georges Canguilhem represent the acme of a French tradition of thought that had already started to historicize epistemology and of which the philosophers and professors at the Sorbonne Lucien Lévy-Bruhl (1857–1939) and Léon Brunschvicg (1869–1944) and the historian Alexandre Koyré (1892–1964) were illustrious exponents (see for example (Lévy-Bruhl 1926) (Brunschvicg, 1912, 1934) (Koyré 1958 [1957])). Although this tradition did not ignore the lesson of previous positivist thinkers such as Comte, it took history more seriously than they did.

Moreover, Chimisso considered Lévy-Bruhl and Brunschvicg the 'fathers' of CHE: the latter inherited their idea that the human mind changes across different times or cultures (Chimisso, p. 3, 2010). Lévy-Bruhl argued that certain traditional non-literate societies thought in a different way from modern people, e.g. they adopted a form of explanation based on supernatural causes, that is, on primary rather than secondary causes. Brunschvicg, on his part, struck by the philosophical implications of the Theory of Relativity, argued that Kant had in fact presented a particular way of thinking, of which Newton's science was the product. In parenthesis, the belief that categories and certain laws and values are timeless and universal had already been the subject of Hegel's criticism. But Brunschvicg, like other French historians of philosophy at the Sorbonne, rejected the idea of laws of development in the history of thought.

We come to see that it was with Lévy-Bruhl and Brunschvicg that the historicization of Kant, of which Hacking presented his own version, started. Lévy-Bruhl had argued that the categories of thought change in different cultures; Brunschvicg had historicized the Kantian categories; Hacking historicizes standards of evidence, way of reasoning and doing and spells out the conditions of possibility of certain sentences.

4.2 Origins of the Idea of Discontinuity

In the tradition of Brunschvicg, Gaston Bachelard (1884–1962) thought that scientific knowledge and common sense differ radically because they are produced by two distinct ways of thinking. In order for scientific knowledge to emerge an ‘epistemological break’ with immediate experience that is rooted in imagination and emotions is necessary. Within scientific thought there have also been epistemological breaks, which have produced new ways of thinking: the lesson of Quantum Theory and Relativity, which had overthrown the old theories of classical physics, was strongly present to his mind.

In respect of discontinuity, Hacking took Bachelard’s tack by arguing for sharp breaks in the history of science. He himself paid obeisance to Bachelard by saying:

I have a revolutionary temper, perhaps under the excessive influence of Bachelard, Kuhn and Foucault [...] I am interested in ruptures that radically transform our methods of reasoning (Hacking 2006a, p. 9)

However, the reasons that underlie the two ‘revolutionary’ attitudes are different and not simply due to the distinctive character of Hacking’s notion of style. While for Hacking styles accumulate, for Bachelard there is no monotonic increase of knowledge: at certain points in history radical revisions of the conceptual foundations of scientific knowledge can happen, although the past can be transformed rather than completely rejected. For example, at the beginning of the twentieth century, the theory of relativity emerged with the consequent rejection of all the basic concepts of classical physics. For him, epistemological breaks like this were the consequence of a new ‘scientific mind’ that had emerged superseding the ‘old Newtonian mind’, which was therefore not eternal and universal.

In Bachelard’s thought ancient ways of thinking now extinct such as the alchemic way of thinking are non-scientific—he distinguishes three stages of historical development: *prescientific*, *scientific* and the phase of the *new scientific mind*, which started with the appearance of the Theory of Relativity. His philosophical attitude was normative: he used modern science as a standard in order to judge certain ways of thinking as ‘non scientific’. Conversely, Hacking’s historical epistemology is not normative—Hacking is reluctant to say that certain ways of thinking are non-scientific, e.g. he did not put forward any criterion that discards Paracelsus’ way of thinking as non-scientific. As we shall see below, the kind of discontinuity proposed by Hacking shows a more direct lineage to Foucault.

4.3 Origins of the Historicization of Objectivity

In classical epistemology the knower had direct access to nature; Bachelard complicated this subject-object relationship—for him ‘the production of knowledge is in a fundamental sense instrumentally mediated’ (Rheinberger 2010, p. 24). Phenomena are not ‘just there’, waiting to be discovered, but must be isolated, purified and investigated through instruments, projected and calibrated by many people according to certain rules, which must be discussed and negotiated. As a consequence, for Bachelard objectivity becomes not something given once and for

all but something that 'is produced in a process of *objectification*, the result of a double instruction—of phenomena and of minds' (Rheinberger 2010, p. 24). In other words, the phenomena are the result of the interaction between the world, a subject and a context; as a consequence, objectivity is established each time in relation to the growing precision of instruments and the negotiations between experts. By 'put[ting] the emphasis on the interface between science, technology, the social structure of the scientific community and the importance of scientific negotiable policies' (Castelão 2010, p. 53 my translation) Bachelard opened up the way for accepting the idea of a concept of objectivity that is variable in the course of history. Hacking developed this aspect of Bachelard's philosophy in his own way: he put the accent on the instrumentally mediated production of knowledge through his idea that human ways of knowing must be understood as ways of thinking *and* doing. Besides, he argued that standards of evidence are not only the result of the development of technology but also of the emergence of new styles. In this respect, his styles project is a step further in respect of Bachelard's view of objectivity: it is a theory that describes how and why it changes.

4.4 Thought Styles Versus Styles of Thinking

In the 1930s the Polish microbiologist Ludwik Fleck (1896–1961) put forward some ideas that showed a striking similarity to those that were emerging in the same period in France: in one of the first chapters of *The Genesis and Development of a Scientific Fact* (Fleck 1979 [1935]), he wrote that epistemology without historical investigations is an empty play on words (Fleck 1979 [1935], p. 21). Fleck introduced the concept of *thought collective* (*Denkkollektiv*), a specific interactive community in which scientific knowledge is produced, and the concept of *thought style* (*Denkstil*), the distinctive mode of thinking of a certain thought collective. Besides important differences, there are many analogies between the notion of thought style and that of style of reasoning.

For Fleck,

[a thought style] is characterized by common features in the problem of interest to a thought collective, by the judgement which the thought collective considers evident, and by the methods which it applies as a means of cognition (Fleck 1979 [1935], p. 98).

In addition, thought styles are maintained by certain communities whose individuals share the same common knowledge and have the same communicative behaviour and literary style. The styles project proposes no equivalent of the notion of thought collective and the idea of a community is rarely explicit. Communicative behaviour and literary styles are important aspects of the notion of thought collective that have been inherited by social constructionism and are not present in Hacking: for example, Shapin and Schaffer describe the literary technologies of Boyle's community (Shapin and Schaffer 1989 [1985], chapter II). It is also to be noted that styles are ways of doing and finding out whereas practical aspects of cognition are less important in Fleck's thought.

Furthermore, for Fleck

[there are] professional and semi-professional thought communities in commerce, military, sports, arts, politics, fashion, science and religion' (Fleck 1979 [1935], p. 107).

For Hacking, on the contrary, the notion of style must capture the idea of communities of people that share the same standard of evidence and adopt the same way of reasoning. Ultimately, the comparison so far suggests that Fleck's notion is more sociological, Hacking's is more epistemological.

Another interesting contrast is that the formation of a thought style can be ascribed to the change in meaning that emerges from a continuous communication between the members of a thought collective. This process of development is *continuous*⁴: 'In the development of ideas, primitive pre-ideas often lead continuously to modern scientific concepts' (Fleck 1979 [1935], p. 100). Contrary to this picture of continuity, Hacking emphasized sudden breaks in history of thought: rather than the slow and continuous transformations of thoughts that pass from an individual to another, what might cause the emergence of a style is, for example, a rapid change in the kind of evidence that people use. In brief, Fleck's thought styles emerge from communicative interactions, mute continuously and die out in a brief span of time. Hacking's styles have clear beginnings and persist for a long period—they are a matter of *longue-durée*. Styles inherit from Crombie the function of organizing the history of science; thought styles have a sociological substance. One of the reasons why styles are more enduring than thought styles—Hacking himself noted—is that 'they are built on fundamental cognitive capacities' (Hacking 2009, p. 27), although these capacities might have been tapped in different ways had the historical circumstances been different.

It is also worth noting that Fleck, before Hacking, had already used Paracelsus' way of reasoning as an example of thought style. Commenting on a passage of the latter he characterized Paracelsus' way of thinking in terms identical to Hacking (see Fleck 1979 [1935], p. 126). Compare:

[Paracelsus'] style of reasoning is alien (Hacking 1983b, p. 71)

Comprehending objects and phenomena in a way similar to our own was completely alien to [Paracelsus's] way of thinking (Fleck 1979 [1935], p. 127).

Fleck asserted that direct communication between the adherents of different thought styles is impossible (Fleck 1979 [1935], p. 36) and justified this point both in terms of impossibility of translating certain terms from a thought style into another and in these terms:

The statement 'Someone recognizes something' [...] is no more meaningful as it stands than the statements 'This book is larger' [...]. Something is still missing, namely the addition, 'than that book', to the statement. Analogously, the statement 'Someone recognizes something' demands some such

⁴ Nicola Mößner supports my point (Mößner 2011).

supplements as 'on the basis of a certain fund of knowledge' or, better, [...] 'in a particular thought style' (Fleck 1979 [1935], p. 38).

In the styles project what we need to *understand* a sentence are the presuppositions of the style (e.g. we need to think and do in a certain way or know the methods and the type of evidence of that style); for Fleck what we need is the 'fund of knowledge' of the thought style, the shared knowledge of the thought collective.

However, Fleck made other strong claims that are absent in the styles project. He thought that the perception of an individual changes when it is embedded in a certain thought style (or 'paradigm' in Kuhn's version of the same claim). Even facts are created by thought styles; truth is a function of the particular thought style that has been accepted—there is no objective truth. Not only does Hacking reject these claims, he also insists that sense-datum statements are represented by style-independent propositions.

4.5 From Foucault's Archaeology to Hacking's Historical Epistemology

Hacking's way of tackling the problem of understanding how objectivity changes throughout history has a more direct link with the methods of analysis of Foucault. With the latter CHE reached a new stage of its reflection on the history of the sciences: Foucault's notion of a 'historical a priori' is constitutive in respect of new kinds of propositions coming into being as objective. In Foucault's words:

What I mean by the term [historical a priori] is an a priori that is not a condition of validity for judgements, but a condition of reality for statements. It is not a question of rediscovering what might legitimize an assertion, but of freeing the conditions of emergence of statements (Foucault 1969 [1972], p. 127).

In *The Order of Things* (1994) Foucault used the term *episteme* to mean the historical a priori in reference to scientific forms of knowledge. In a certain epoch, an episteme is a mode of thought whose system of rules operates under the surface of our consciousness and determines the boundaries of what can be thought and therefore made sense of. There is no continuity between one episteme and another and it is the task of 'archaeology' (Foucault's historiographic method) to dig into the thought of a certain epoch to identify and describe its episteme. In emphasizing discontinuity Foucault linked up with the studies of Bachelard and Canguilhem and their heterogeneous vision of history of the sciences.

I wish to set out three reasons why it is possible to say that Hacking developed the notion of style by adopting Foucault's perspective. First of all, Hacking considered the notion of style as a particular element of the episteme, the *decisive* element that is necessary to understand the emergence of new true-or-false sentences. As he put it:

I do not say that 'style of reasoning' means Foucaultian 'episteme' or whatever. On the contrary, if one could adequately define an episteme, one would surely have to include, as one of its elements, the styles of reason that

bear on the positive propositions of that field of knowledge (Hacking 2002a, p. 181).

In other words, for Hacking, of all the elements that characterize an episteme, e.g. assumptions, unspoken truths, institutions, knowledges, social activities, the material traces left behind by a particular epoch, what really counts in order to understand the emergence of new true-or-false statements is the style of reasoning, understood as I have described it in Sect. 2. Therefore, Hacking works in Foucault's perspective in that he aims to discover the conditions of validity of statements by using what might be considered an element of the episteme.

Secondly, for Foucault

Archaeology does not seek to rediscover the continuous, insensible transition that relates discourses, on a gentle slope, to what precedes them, surrounds them, or follows them [...] On the contrary, its problem is to define discourses in their specificity; to show in what way the set of rules that they put into operation is irreducible to any another (Foucault 1969 [1972], p. 139)

In a similar way, the styles project is 'archaeological' in nature. It is not interested in those transitional zones between the phase that precedes the emergence of a style and its crystallization, for example in describing the continuous stages of refinements undergone by certain methods, instruments and practices. Rather, what counts is to discover the standards of truth, the questions, the criteria of evidence, the way of thinking and doing, i.e. the presuppositions that characterize the new style; and to do so it might be necessary to set up the presuppositions of a new style against those of others.

Finally, James Elwick highlighted the importance of *possibility* in the works of Hacking: 'Hacking's style of reasoning and Foucault's *episteme* are both conditions that make possible phenomena such as positive statements, new sciences and concepts' (Elwick 2012, p. 4). Therefore the model of layered conditions of possibility (stratigraphical model) can be applied not only to Foucault but also to Hacking. Following Elwick, the styles project can be viewed as an analysis of different strata of possibilities: the first stratum made of contingent historical circumstances, the second stratum of styles, the third stratum of new objects, sentences and other epistemological items which become 'objective', shared by an entire community of people.

5 Conclusions

I have showed some important connections between Hacking's styles project and historical epistemology. My analysis shows that the notion of style of reasoning can be better understood when it is put in connection with another notion, the notion of organizing concept, which I consider the core of historical epistemology. Organizing concepts play a role similar to Kantian pure concepts in that they structure our thoughts about the world and organize a whole collection of sub-concepts, practices and values (Sects. 3.2). However, whereas Kantian pure

concepts are timeless, organizing concepts change or emerge out of radical historical transformations (Sects. 3.3, 3.4). The notion of style of reasoning is not an organising concept itself but is an analytical tool which helps to understand these radical historical transformations, in particular how organizing concepts such as objectivity and probability change or come about over history. On the other hand, to study of the organizing concepts of objectivity and probability is relevant to understanding the genesis and the development of styles of thinking (e.g. the statistical style). As a consequence, the styles project falls into the field of historical epistemology, viewed as the study of organizing concepts (Sects. 3.6).

A salient point of my analysis is that Hacking's is one of the projects of historical epistemology that historicize Kant. For example, there are substantial convergences between the styles project and Daston and Galison's study on objectivity (Sect. 3.7). Furthermore, an insight into the notion of style can be gained by an analysis of *classical* historical epistemology to which I have traced back many ideas of the styles project (Sect. 4).

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